Electrical Failure Analysis expansion for ONPY2

Subject:

Advantages of upgrading PHEMOS-1000 photoemission microscope with laser scanning and OBIRCH/TIVA module

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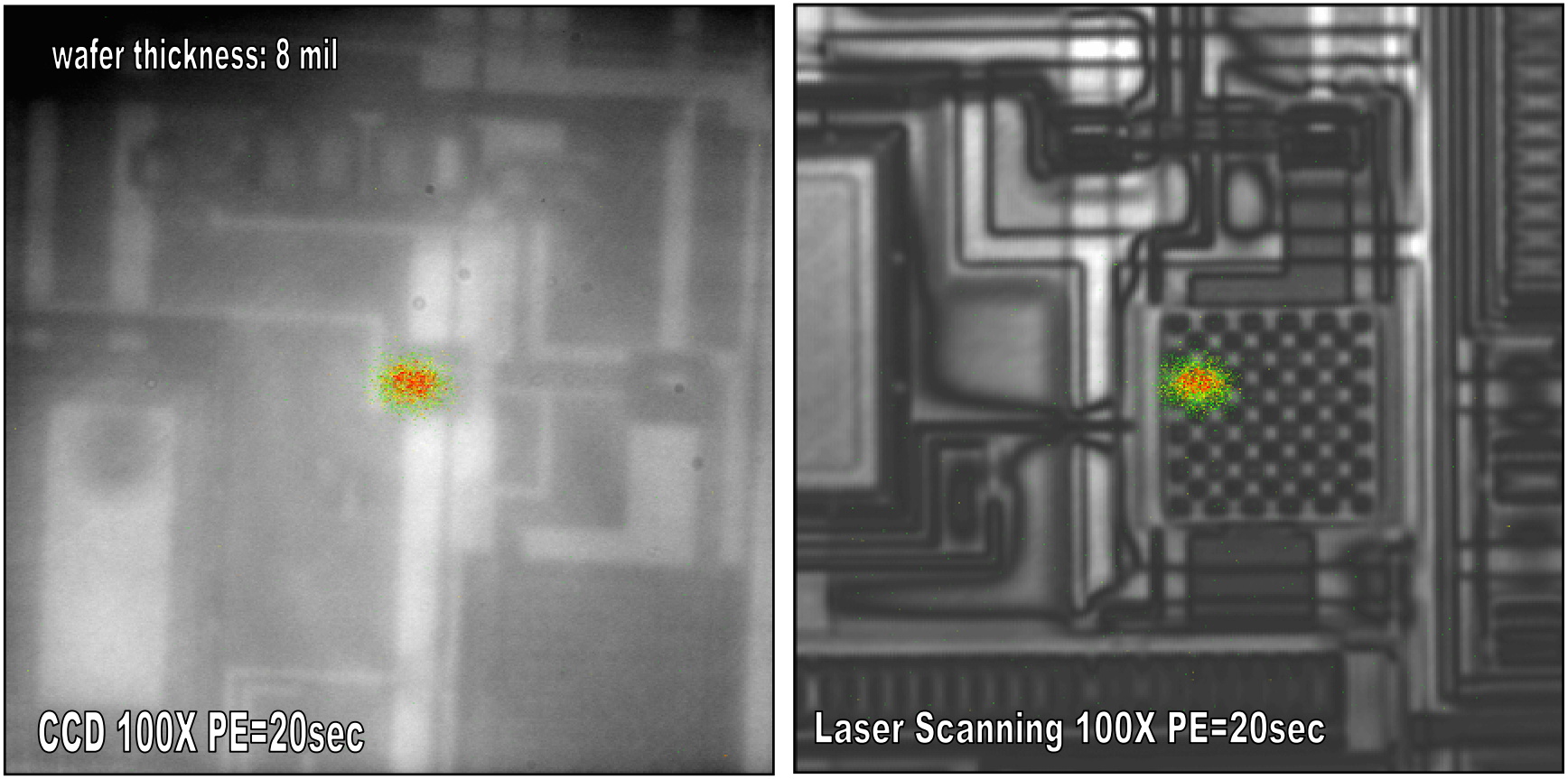
Photoemission image quality (backside I-R CCD versus IR-laser scanning)



Since pattern image is taken from the back-side of the wafer, its quality depends on wafer thickness (the thinner the better quality of the pattern image). The comparison of pattern images taken by back side IR + CCD versus IR laser scanning is shown above. As can be seen the quality of the pattern image taken by laser scanning is substantially better compared to the regular I-R CCD. (Note: photoemission image is shifted because used demo system was not calibrated). **Improved pattern image laser scanning can be applied in many further failure techniques (see following slides).**

TIVA, IR-OBIRCH techniques (Laser Induced Thermal Stimulation, source: Hamamatsu)

TIVA (Thermally Induced Voltage Alteration) is powerful defect analysis tool for fast localization of device defects, particularly the defects found in metal interconnections such as voids, short circuits and resistive vias. The voltage alteration data overlays the LSM image to support the full range of laser-based failure analysis techniques available including TIVA, LIVA (Light Induced Voltage Alteration), OBIC (Optical Beam Induced Current), OBIRCH and SEI (Seebeck Effect Imaging).

Thermal laser stimulation is able to:

- localize current related defects from the front side as well as from the backside of ICs
- metallic defects such as Micro-bridges, parasitic vias, etc.
- non metallic defects such as melted poly-silicon or melted silicon spikes
- Affected vias and contacts
- defects in capacitors and other structures
- Gate related defects: Melted polysilicon or silicon spike in the silicon oxide
- practically localizes defects where phonon emission is not generated

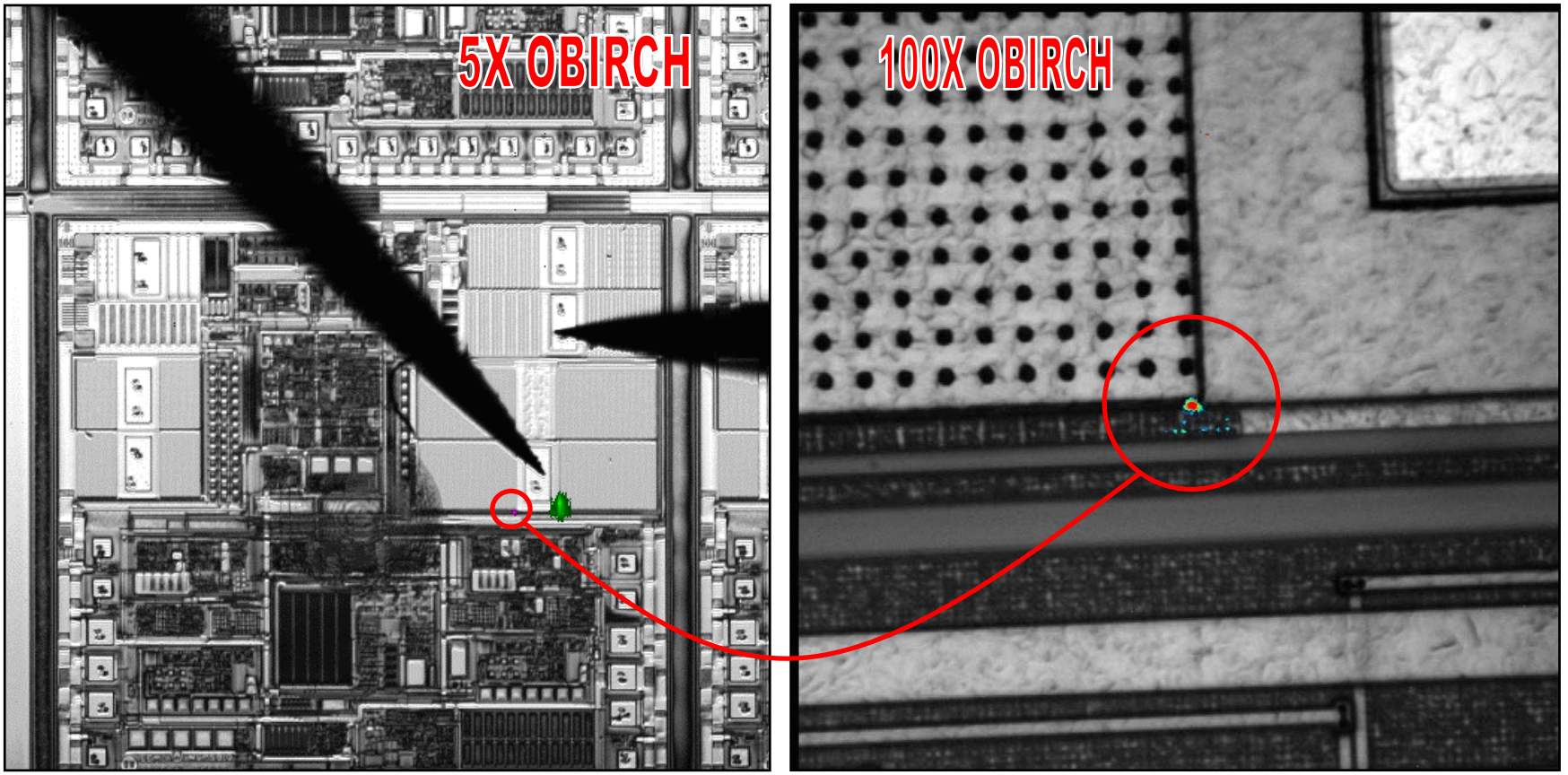
Advantages:

- Thermal laser stimulation (TLS) can precisely localize the physical defect
- No spatial or temporal shift between “hot spot” and laser spot center
- No significant thermal spreading
- EMMI (Emission comes from mechanisms such as high field) is not as precise as TLS

Microscopy are complementary

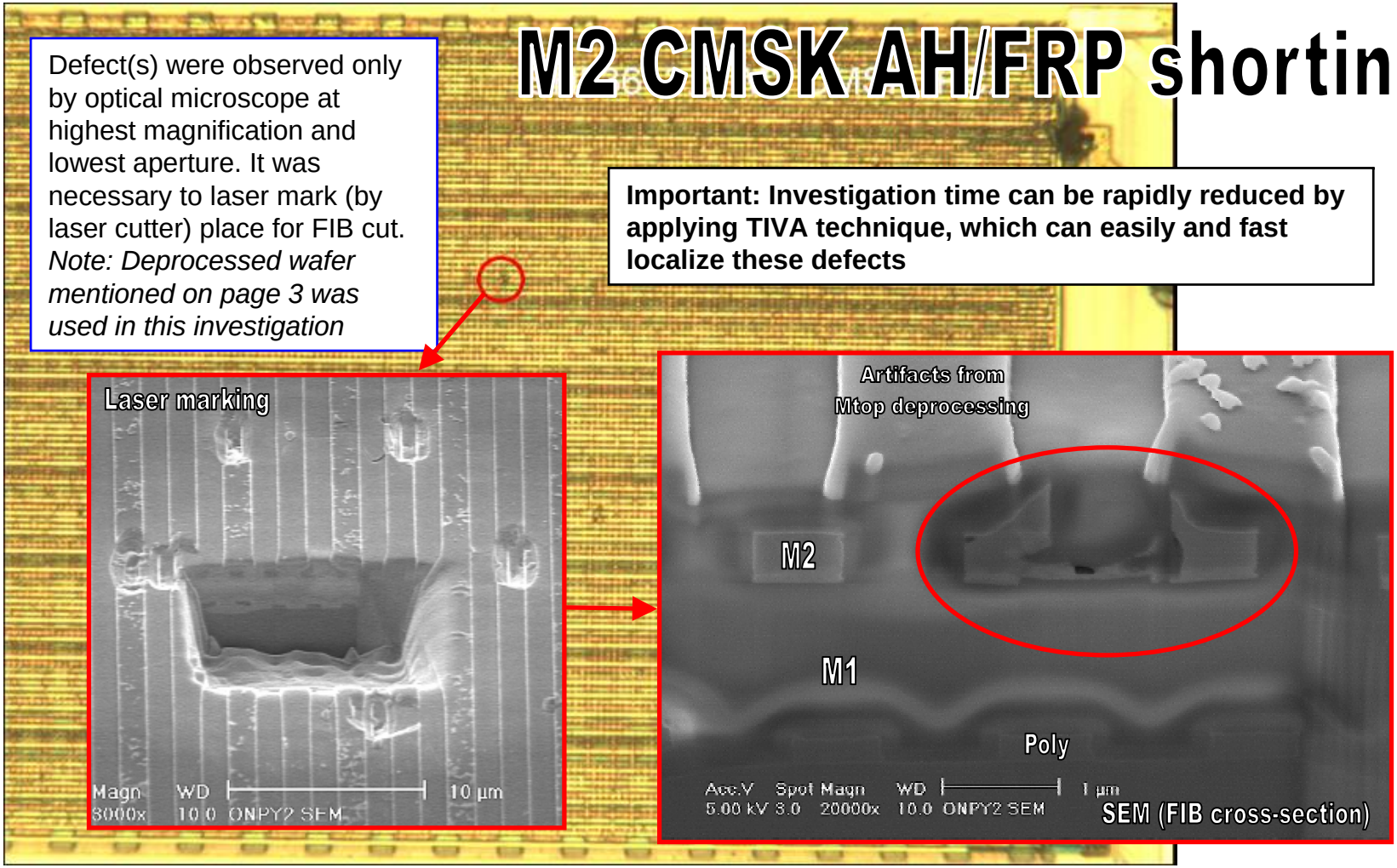
- Emission microscopy and thermal laser stimulation on the same tool is the right way to go

Practical application of OBIRCH (to ONPY rejected NCP5810, using Hamamatsu DEMO tool)



Rejected unit was used for investigation (the lot yielded poorly about 30%). OBIRCH clearly localized place where change of the resistance was marginal. In parallel investigation in PAL was on-going. The root cause found by PAL: incomplete removal of the polysilicon which caused a short to Metal1 in INV_PWR_PMOS. Detailed report is available only for internal purposes.

Example of possible application TIVA



Note: Detailed report is located: for internal purposes only

Conclusion / summary

Laser scanning upgrade advantages

- **substantial improvement of backside pattern images for photoemission detection**
- **thickness of the wafer does not affect pattern image quality - possible to use thicker wafers for back side PE**
- **Extension of PEM by TLS module (Thermal laser stimulation) for precise failure analysis**

TIVA/OBIRCH upgrade advantages

- **Opens new possibility for detection and localizing of metallic, non-metallic (polymer) defects, affected vias and contacts, defects in capacitor dielectrics, gate related defects and others that are not visible by photoemission**
- **Thermal laser stimulation (TLS) can precisely localize the physical defect**
- **No spatial or temporal shift between "hot spot" and laser spot center**
- **No significant thermal spreading**
- **EMMI (Emission comes from mechanisms such as high field) is not as precise as TLS**
- **Microscopies are complementary, Emission microscopy and thermal laser stimulation on the same tool is the right way to go**

Issues and Experiences in ONPY2

- **Capacitor leakages, remaining polysilicon, affected and broken VIAS, leakages, etc...**

Note: Figures and results shown in this presentation were obtained from the demo tool at Hamamtsu area (if not mentioned differently) where ONPY2 material was put under investigation. Acknowledge to Mr. Ortner for his support.

Summary: As shown above TIVA technique may help to localize many of previously observed defects on all technologies in ONPY2, thus reduce investigation time and reduce FAB scrap.